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भाग 5 विशेष लक्षण

अनुभाग 2 टेंकर

Indian Standard

ELECTRICAL INSTALLATIONS IN SHIPS — SPECIFICATION

PART 5 SPECIAL FEATURES

Section 2 Tankers

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Electrical Equipment and Installations in Ships Sectional Committee, ET 26

FOREWORD

This Indian Standard (Part 5/Sec 2) was adopted by the Bureau of Indian Standards, after the draft finalized by the Electrical Equipment and Installations in Ships Sectional Committee had been approved by the Electrotechnical Division Council.

While preparing this standard, assistance has been derived from IEC Pub 92-502 (1994) 'Electrical installations in ships : Part 502 : Special features — Tankers'.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard
ELECTRICAL INSTALLATIONS IN SHIPS — SPECIFICATION
PART 5 SPECIAL FEATURES
Section 2 Tankers

1 SCOPE

1.1 This standard is applicable, unless otherwise indicated, to all types of tankers defined in **3.1** and states general conditions and also particular conditions for each type of tankers as stipulated in **5** to **9.3**.

2 REFERENCES

2.1 The Indian Standards listed in Annex A are necessary adjuncts to this standard.

3 DEFINITIONS

3.1 Tankers

A sea-going cargo ship constructed or adapted for the carriage in bulk of liquid cargoes of a flammable or of an otherwise potentially hazardous nature. According to the nature of the cargo, the following types of tankers are considered:

Type A	Oil tankers for the carriage in bulk of oil cargoes having a flashpoint (closed cup test) not exceeding 60°C;
Type B	Oil tankers for the carriage in bulk of oil cargoes having a flashpoint (closed cup test) in excess of 60°C;
Type C	Tankers for the carriage in bulk of Liquefied Natural Gas (LNG), Liquefied Petroleum Gasses (LPG) and of certain gases liquefied by pressurization or refrigeration; and
Type D	Tankers for the carriage in bulk of other liquid cargoes, for chemicals, having a flammable or unstable or reactive or correct property or a combination of any two or more of these properties.

3.2 Hazardous Areas in Tankers

Hazardous areas are those places where flammable or explosive vapours or gases may normally be expected to accumulate. The areas are given in **4** to **8.2** of this standard. It shall be noted that, where applicable, they are described for two conditions, namely:

a) during all normal operational conditions, and

b) during cargo handling, ballasting or gas-freeing operation when the hazardous areas may extend beyond those defined for (a) above.

Enclosed and semi-enclosed spaces which do not contain a source of hazard but which has openings into a hazards area shall be considered hazardous. Certain exceptions are permitted for Type C tankers (*see* **6.3**).

NOTES

1 Semi-enclosed spaces shall be considered as spaces limited by decks and/or bulkheads in such a manner that the natural conditions of ventilation are notably different from those obtained on open deck.

2 The mechanical ventilation arrangements of enclosed and semi-enclosed spaces which contain a source of hazard shall comply with the following:

a) Electric motors driving fans shall be placed outside the ventilation ducting. Ventilation fans shall not produce a source of vapour ignition in either the ventilated space or the ventilation fans and the ducting surrounding fan impellers shall be of non-sparking construction defined as having;

    i) impellers or housings of non-metallic construction, due regard being paid to the elimination of static electricity, or

    ii) impellers and housings of non-metallic materials,

    iii) impellers and housings of austenitic (stainless) steel, and

    iv) clearance between impellers and housings sufficient to prevent contact in the event of bearing failure.

Any combination of an aluminium or magnesium alloy fixed or rotating component, regardless of tip clearance, is considered a sparking hazard and shall not be used for ventilating the spaces under consideration.

The foregoing requirements shall also apply to the mechanical ventilation arrangements of air-locks and of spaces protected by air-locks.

When approved by an appropriate authority driving ventilating fans may be located within the ducting subject to such motors being provided with an enclosure (degree of protection, at least, IP 44) which prevents the direct impingement of the airstream upon the motor casing.

3 The classification of harardous areas into zones 0, 1 and 2 are based upon IS 5572 (Part 1).

3.3 Certified Safe-Type of Equipment

When reference is made hereafter to equipment of a 'certified safe type' it means electrical equipment for which satisfactory guarantees are furnished to the relevant authorities concerning the safety of its operation in the flammable atmosphere concerned.

NOTES

1 Such guarantees are to be supplied in the form of test certificates issued by independent and competent institutions and established on a basis at least equivalent to relevant Indian Standard Specifications on Electrical Apparatus for Explosive Gas Atmospheres.

2 In choosing the various types of certified safe-type of equipment to be used for the various applications, consideration shall be given to the particular conditions on board ship, to the necessity that the equipment should not require frequent maintenance.

3 Particular requirements for certified safe-type of equipment are given in Annex B to this standard.

3.3.1 Such types of certified safe-type of equipment as mentioned below may be considered:

a) Luminaires:

   i) Pressurized, type '*p*' (that is, air driven or pressurized by means of air or inert gas);

   ii) flameproof, type '*d*'; and

   iii) increased-safety, type '*e*'.

b) Branch connection boxes:

   i) increased safety, type '*e*'; and

   ii) flameproof, type '*d*'.

c) Control, measuring monitoring and communications equipment or circuits, including portable radio transmitters/ receivers:

   i) Intrinsically safe, type '*i*' (categories '*ia*' and '*ib*').

   In applications where this is impracticable, for example, valve actutators, gas detection sensors, the following type of protection may be considered in place of category '*ib*' apparatus when approved by an Appropriate Authority;

   ii) pressurized, type '*p*' (by means of air or inert gas);

   iii) flameproof, type '*d*'; and

   iv) increased safety, type '*e*'.

d) Motors:

   i) increased-safety, type '*e*' with flameproof, type '*d*' enclosure;

   ii) pressurized, type '*p*' (by means of air, inert gas or water);

   iii) flameproof, type '*d*'; and

   iv) increased-safety, type '*e*'.

NOTE — Dependent upon their location, where necessary, motors shall have a degree of protection of enclosure of IP 56 in accordance with IS 10242 (Part 2/Sec 1).

e) Portable lamps

   i) intrinsically safe, type '*i*' or flameproof, type '*d*', or increased-safety, type '*e*' each with self-contained battery; and

   ii) air-driven type with pressurized enclosure, type '*p*'.

3.4 Electrical Apparatus with Type of Protection '*n*'

3.4.1 Electrical apparatus which has a type of protection such that during its normal operation, it is not capable of igniting a surrounding explosive gas/air mixture and a fault capable of causing ignition is unlikely to occur.

Such apparatus shall be constructed with type of protection '*n*'.

Where reference is made hereafter to equipment of a type which ensures the absence of sparks or arcs and of 'hot spots' during its normal operation, electrical apparatus with the type of protection '*n*' may be considered subject to the following requirements:

i) the apparatus is constructed and so marked for use in a 50°C ambient temperature, and

ii) the apparatus is approved for use in the flammable atmosphere(s) concerned by a recognized authority.

4 GENERAL

4.1 Ship's Service Systems of Supply

See IS 10242 (Part 2/Sec 1). Any earthed system with or without hull return shall not be permitted; for exception, *see* **4.5.2** and batteries shall be separated from cargo tanks by cofferdams or equivalent spaces and from cargo pump-rooms by oil-tight and gas-tight bulkheads.

4.2 Wiring

Electric wiring shall not be installed in hazardous areas unless essential for operational purpose and when permitted by the requirements detailed in IS 10242 (Parts 1, 3 and 4). In such instances all cables and their installations shall, in addition to the requirements of the relevant Part, comply with the requirements of **4.2.1** to **4.2.6** inclusive, as appropriate.

4.2.1 All cables installed in hazardous area shall be sheathed with at least one of the following:

a) A non-metallic impervious sheath in combination with braiding or other metallic covering for earth detection and mechanical protection;

b) Lead sheath plus further mechanical protection, for example, armous braiding or non-metallic impervious sheath; and

c) Copper or stainless steel sheath (for mineral-insulated cables only). Aluminium sheathed mineral-insulated cables may be considered for special application, for example, in cargo tanks of liquefied gas carriers.

4.2.2 All metallic covering of power and lighting cables passing through a hazardous area, or connected to equipment in such an area, shall be earthed at least at each end. The metallic covering of other cables in the hazardous areas shall be earthed at least at one end [*see* **18** of IS 10242 (Part 3/Sec 12) and **37** of IS 10242 (Part 4)].

NOTE — Special consideration shall be given to single-cored cables for ac power or dc semiconductor controlled systems; in such cases earthing at a single point within the hazardous area may be preferable.

4.2.3 Where corrosion may be expected, a non-metallic impervious sheath shall be applied over metallic sheaths or armour of cables for corrosion protection.

4.2.4 Cables installed on deck or on fore and aft gangways shall be protected against mechanical damage. Cables and protective supports shall be so installed as to avoid strain or chafing and due allowance made for expansion or working of the structure. When expansion bends are fitted they shall be accessible for maintenance.

4.2.5 Cables installed in pump-rooms shall be suitably protected against mechanical damage.

4.2.6 Cables associated with intrinsically safe circuits shall be used only for such circuits and separated from other cables containing non-intrinsically safe circuits (for example, cables not laid together in the same cable bundle or pipe and not secured by the same fixing clip). The circuits of Category '*ia*' instrinsically safe systems shall not be contained in a cable which also contains a circuit or circuits associated with a Category '*ib*' intrinsically safe system.

NOTE — All necessary steps shall be taken when selecting the types of cable and when installing them to prevent the intrinsically safe characteristics being jeopardized by induction phenomena. Reference may also be made to IS 10242 (Part 3/Sec 10, 11, 12, 13 and 19).

4.3 Portable Lamps

No portable lamps other than certified safe-type lamps shall be used in hazardous areas and the flexible cables for such lamps shall not pass through these areas.

4.4 Hull Currents

Hull currents which could arise from the following are not considered as being prohibited by application of **4.1**;

a) the use of sacrificial anode protective systems, or impressed current protective systems for outer hull protection only;

b) limited and locally earthed systems, such as starting and ignition systems of internal combustion engines;

c) insulation level monitoring devices, provided the circulation current of the device does not exceed 30 mA under the most unfavourable conditions; and

d) the earthing of the neutral of power distribution systems of voltages above 1 kV, provided that any resulting current does not flow directly through any of the hazardous areas defined by this standard.

5 PARTICULAR CONDITIONS APPLYING TO TYPE 'A' TANKERS

5.1 Hazardous Areas

In Type A tankers the hazardous areas during all normal operational conditions include:

a) cargo tanks and cargo piping;

b) cofferdams and permanent (that is, segregated) ballast tanks adjacent to cargo tanks;

c) cargo pump-rooms;

d) Enclosed or semi-enclosed spaces immediately above cargo tanks (for example, between decks) or having bulkheads above and in the line with cargo tank bulkheads;

e) enclosed or semi-enclosed spaces immediately above cargo pump-rooms, or above vertical cofferdams adjacent to cargo tanks, unless separated by a gas-tight deck and suitably mechanically ventilated;

f) spaces, other than cofferdams, adjacent to and below the top of a cargo tank (for example, truncks, passage-ways and holes);

g) areas on open deck, or semi-enclosed spaces on open deck, within 3 m of any cargo tank outlet or gas or vapour outet;

h) areas on open deck over all cargo tanks (including all ballast tanks within the cargo tank area) and to the full width of the vessel plus 3 m fore and aft on open deck, up to a height of 2.4 m above the deck (*see also* Note 2 below);

j) compartments for cargo hoses; and

k) enclosed or semi-enclosed spaces having an opening into any hazardous areas.

NOTES

1 Spaces forward of the areas referred to in **5.1** (h) above which are below the level of the main deck and which have a direct opening on to the main deck are not considered hazardous, provided that:

i) the entrances to such spaces do not face the cargo tank area and are sited at least 5 m from the foremost cargo tank or 10 m measured horizontally from any cargo tank outlet or gas or vapour outlet, whichever is greater;

ii) the spaces are mechanically ventilated with the air inlet(s) to the system(s) sited at about 10 m vapour outlet; and

iii) all other openings to the spaces, including ventilation system exhaust are sited forward of the entrances to the spaces and at a distance of at least 10 m measured horizontally from any cargo tank outlet or gas or vapour outlet.

2 Where the deck continues at the same level as the cargo tank deck at the side of accommodation quarters, the area referred to in **5.1** (h) above shall be extended by at least 3 m but not more than 5 m along the side or sides of such quarters and up to a 2.4 m above the deck.

5.2 During cargo handling, ballasting or gas-freeing operations the hazardous areas on open deck may extend up to 10 m from a cargo tank outlet or gas or vapour outlet.

5.2.1 Any enclosed or semi-closed spaces (not containing a source of hazard which have opening, including those for ventilation systems, which are located within 10 m measured horizontally from such cargo tank, gas or vapour outlets, also areas on open deck which are located special consideration (*see* **5.3.9**).

5.3 Electrical Equipment in Hazardous Areas

Electrical equipment and wiring shall not be installed in any of the defined hazardous areas unless essential for operational purposes when the installation of equipment and wiring complying with **5.3.1** to **5.3.10** may be considered.

5.3.1 *Cargo Tanks and Cargo Piping*

5.3.1.1 Category '*ia*' intrinsically safe apparatus and its associated wiring only.

5.3.2 *Cofferdams and permanent (that is, Segregated) Ballast Tanks Adjacent to Cargo Tanks*

5.3.2.1 Hull fitting containing transducers for electrical depth sounding or log devices or containing the terminals or shell plating penetrations for anodes or electrodes of an impressed current cathodic protection system for underwater hull protection, provided that such fitting are of gas-tight construction or are housed within a gas-tight enclosure and are not located adjacent to a cargo tank bulkhead. All associated cables passing through these spaces shall be installed in heavy gauge steel pipes with gas-tight joints up to the main deck. Corrosion-resistant pipes, giving adequate mechanical protection, shall be used in compartment which may be filled with sea water.

5.3.2.2 Category '*ia*' intrinsically safe apparatus and circuits.

5.3.3 *Cargo Pump-Rooms*

5.3.3.1 Electrical devices as described in **5.3.2** above which shall be installed in accordance with that subclause.

5.3.3.2 Certified safe-type luminaires of the pressurized or flameproof type shall be arranged on at least two independent final sub-circuit (*see* Note below). All switches and protective devices shall interrupt all poles or phases and shall be located in a non-hazardous area. The luminaires, switches and protective devices shall be suitably labelled for identification purposes.

NOTE — This arrangement permits light from one circuit to be retained while maintenance is carried out on the other.

5.3.3.3 Where it is necessary for cables other than those of intrinsically safe circuits and those cables supplying the luminaires referred to in **5.3.3.2** above, to pass through cargo pump room entrances, they shall be installed in heavy gauge steel pipes with gas tight joints.

5.3.3.4 Category '*ia*' (or '*ib*') intrinsically safe apparatus and circuits.

5.3.3.5 General alarm audible indicator and flameproof indicators may exceptionally be allowed.

5.3.4 *Enclosed or Semi-Enclosed Spaces Immediately Above Cargo Tanks (for example, Between Decks) or Having Above and in Line with Cargo Tank Bulkheads*

Enclosed or semi-enclosed spaces immediately above cargo pumprooms or above vertical cofferdams adjacent to cargo tanks unless separated by a gas-tight deck and suitably mechanically ventilated. Compartments for cargo hoses

5.3.4.1 *Certified safe-type luminaires as under* **3.3.1** (a).

All switches and protective devices shall to interrupt all poles or phases and shall be located in a non-hazardous area. The luminaires, switches and protective devices shall be suitably labelled for identification purposes.

5.3.4.2 *Intrinsically safe apparatus and circuits*

5.3.4.3 *Through-runs of cables*

5.3.5 *Spaces, other Than Cofferdams, Adjacent to and Below the Top of Cargo Tank (for example, Trunks, Passage-ways and Holds)*

5.3.5.1 Electrical devices as described in **5.3.2.1** above which shall be installed in accordance with the requirements specified therein.

5.3.5.2 Certified safe-type luminaires of the pressurized type of flameproof type arranged on at least two independent final sub-circuits. All switches and protective devices shall interrupt all poles or phases and shall be located in a non-hazardous area. The luminaires, switches and protective devices shall be suitably labelled for identification purposes.

5.3.5.3 *Intrinsically safe apparatus and circuits.*

5.3.5.4 General alarm audible indicator, flameproof indicators may exceptionally be allowed.

5.3.5.5 Through-runs of cables, excepting those for intrinsically-safe circuits, such cables require special consideration.

5.3.6 Areas on open deck or semi-enclosed spaces on open deck, within 3 m of any cargo tank outlet or gas or vapour outlet.

For example, areas within 3 m of cargo tank hatches, sight ports, tank cleaning openings, hullage openings, sounding pipes, cargo pump-room entrances, cargo vapour outlets or ventilation outlets for cargo pump-rooms, cargo pump-room entrances, cofferdams and cargo tanks.

5.3.6.1 Certified safe-type equipment as mentioned in **3.3** and suitable for use on open deck.

5.3.6.2 Through-runs of cables: cable expansion bends shall not be fitted in these areas.

5.3.7 Areas on open deck over all cargo tanks (including all ballast tanks within the cargo tank area) and to the full width of the vessel plus 3 m fore and aft on open deck, up to height of 3.4 m above the deck.

5.3.7.1 Certified safe-type equipment as mentioned in **3.3** and suitable for use on open deck.

5.3.7.2 *Through-runs of cable*

5.3.8 Enclosed or semi-enclosed spaces (not containing a source of hazard) having an opening into any hazardous area.

5.3.8.1 The electrical installation shall comply with the requirements for the space or area into which the opening leads; suitability for open deck conditions may need to be considered in the case of semi-enclosed spaces.

5.3.9 Enclosed and semi-enclosed spaces (not containing source of hazard) which have openings, including those for ventilation system, which are located more than 3 m from a cargo tank outlet or gas or vapour outlet and which are within 10 m measured horizontally from these outlets.

5.3.9.1 Equipment of a type which ensures the absence of sparks or arcs and of 'hot spots' during its normal operation (*see* Note 1 to **5.3.10** *and also* **3.4**) or of a certified safe-type.

5.3.10 *All Areas on Open Deck*

Transmission aerials, also rigging, for example, stays, provided consideration is given to their sitting in relation to the location of gas and vapour outlets.

NOTES

1 In instances where the use of equipment of the type which ensures the absence of sparks or arcs and of 'hot spots' is permitted within the hazardous areas defined in 5.2. No part of such equipment shall have an operating temperature exceeding the ignition temperature of the gases or vapour of the cargo or cargoes to be carried. Futhermore, such equipment shall be approved by a recognized authority.

2 During loading, discharging and ballasting operations, and during gasfreeing by mechanical means, gases or vapour may be present on open deck outside the hazardous areas mentioned in 5. Due to such possible extensions of the hazardous areas, exposed equipment located on deck and on superstructures which could be in use during such operations, for example, luminaires, winches, bridge wing apparatus, etc, shall have an enclosure of a degree of protection of, at least, IP 56, or is totally encapsulated or is of a type which ensures the absence of sparks or arcs and of 'hot spots' during its normal operation or has type of protection '*n*' is of a certified safe-type, the operating temperature limitation referred to in Note 1 above shall also apply to equipment protected by encapsulation.

3 The requirements of 5.3 do not preclude the use of winding temperature monitoring sensors in flameproof, pressurized or increased safety type motors. Associated cabling be installed in accordance with the appropriate section of 5.3.

5.4 Cargo Pump-Rooms

5.4.1 Electric motors driving equipment located in cargo pump-room spaces shall be separated from these spaces by a gas-tight bulkhead or deck, flexible couplings or other means of maintaining alignment shall be fitted in the shafts between the pumps and the motors and, in addition, suitable stuffing boxes shall be fitted where shafts pass through gas-tight bulkheads or decks. Ventilation arrangements shall be such that an over pressure may be normally maintained in the compartment or space containing the electric motors relative to that or the cargo pump-room spaces.

5.5 Compartments for Electric Motors of Cargo Pump or Cargo Stripping Pumps Situated Vertically Above Pump-Rooms

5.5.1 Where electrically driven pump motors are installed in special compartments above cargo pump-rooms, the requirements given in **6.1** are applicable where the location and arrangement of the compartment indicate that gas may be accumulated, mechanical ventilation shall be provided. Interlocking with the ventilation system shall also be provided to prevent the energizing of electrical equipment other than that of a certified safe-type and to prevent the starting of the cargo pump motors until the compartment has been satisfactorily ventilated.

5.6 Between-Deck Spaces

5.6.1 Any electrical equipment additional to luminaires referred to in **6** may be installed in between-deck spaces immediately above cargo tanks provided that such equipment is housed in a suitably mechanically ventilated compartment having access solely from the deck above and of which the floor is separated from the cargo tanks by a cofferdam and the between-deck space.

6 PARTICULAR CONDITIONS APPLYING TO TYPE B

6.1 General

Type B tankers are of two main types:

a) Tankers for the carriage of bituminous or asphalt products, and

b) Tankers for the carriage of fuel oil or diesel oil.

6.2 Types of Electrical Equipment to be Used

It is generally considered that Type B tankers do not present risks due to flammable or explosive vapours of gases as far as electrical equipment is concerned; in these conditions, the requirements under 4 do not apply to such tankers and no hazardous areas are considered. However, it is emphasised that it is always advisable to reduce the potential sources of ignition and it is prudent to observe the following practices;

a) That remote monitoring circuits which are in direct contact with the cargo, be intrinsically safe;

b) That electric motors driving pump, and which are located in cargo pump-rooms, be of the type which ensures the absence of sparks or arcs and of 'hot spots' during its normal operation (*see* **5.3**, Note 1, and *also* **3.4**) or be of a certified safe-type; and

c) That portable electrical equipment to be used in tanks are of certified safe-type.

6.3 Limitations

Ships intended and built for the carriage in bulk of oil cargoes having a flash-point (closed cup test) in excess of 60°C shall under no circumstance be used for the carriage of other types of flammable cargo, nor shall they be used for the carriage of cargoes which are heated to within 15°C below their closed cup test flash-points.

Ships intended to carry bituminous or asphalt products which will be heated to temperatures which are in excess of 15°C below their closed cup test flash-point shall have electrical installations which comply with **8.2.2** and **8.2.3**.

7 PARTICULAR CONDITIONS APPLYING TO TYPE C TANKERS

NOTE — The hazardous cargoes relevant to this clause together with required data and special requirements, where applicable, are given in Annex C to this standard.

7.1 Hazardous Areas

In Type C tankers, the hazardous areas during all normal opertional conditions include:

a) cargo containment systems and cargo piping;

b) holds spaces where cargo is carried in a cargo containment system requiring a secondary barrier;

c) hold spaces where cargo is carried in a cargo containment system not requiring a secondary barrier;

d) spaces separated from the hold spaces described in item (b) above by a single gas-tight steel boundary;

e) cargo pump-rooms and cargo compressor rooms;

f) areas on open deck, or semi-enclosed spaces on open deck, within 3 m of any cargo outlet, gas or vapour outlet, cargo pipe flange, cargo valve, or entrances and ventilation opening to cargo pump rooms and cargo compressor rooms;

g) areas on open deck over all the cargo area and 3 m forward and aft of the cargo area on open deck up to a height of 2.4 m above the weather deck;

h) areas within 2.4 m of the outer surface of a cargo containment system where such a surface is exposed to the weather;

j) enclosed or semi-enclosed spaces in which pipes containing cargo products are located (*see* Note 5 below);

k) compartments for cargo hoses;

m) enclosed or semi-enclosed spaces adjacent to cargo pump-rooms or cargo compressor rooms unless separated by a gas-tight deck or bulkhead and suitably mechanically ventilated; and

n) enclosed or semi-enclosed spaces (not containing a source of hazard) having an opening into any hazardous area. For exceptions, *see* **7.3**.

NOTES

1 For the purpose of (g) the cargo area i[illegible]ned as that part of the ship which contains the cargo containment system and cargo pump and compressor rooms and includes deck areas over the full beam and length of the ship above the foregoing. Where fitted, the cofferdam, ballast or void spaces at the after end of the aftermost hold space or the forward end of the forwardmost hold space are excluded from the cargo area.

2 For vessels intended for the carriage of LPG or other gases which, at normal atmospheric pressure, are heavier than air spaces which are forward of the area referred to in 7.1 (g) above, which are below the level of the main deck and which have a direct opening onto the main deck are not considered hazardous, provided that;

a) the entrance to such spaces do not face the cargo area and are sited at least 5 m from the foremost cargo tank or 10 m measured horizontally from any gas or vapour outlet within the cargo containment on handling system, whichever is the greater;

b) the spaces are mechanically ventilated with the air inlet(s) to the system(s) sited at least 10 measured horizontally from any gas or vapour outlet; and

c) all other opening to the spaces, including ventilation exhausts, are sited forward of the entrance to the spaces and at a distance of at least 10 m measured horizontally from any gas or vapour outlet.

3 For vessels intended solely for the carriage of LNG or other gases which, at normal atmospheric pressure, are lighter than air, the requirements contained in Note 2 above shall apply excepting that the considered spaces do not require to be mechanically ventilated.

4 In respect of (1):

a) The installation of gas detection equipment in a space shall not render that space hazardous provided that gas sampling lines have shut-off valves or equivalent area and that exhaust gases from the detection equipment are discharged directly into the atmosphere at a point outside the defined sources; and

b) Similarly, spaces containing boil-off gas fuel burning systems are not considered hazardous provided suitable precautions are taken, for example, double wall piping and ventilation, gas detection, inerting equipment, etc.

7.2 During cargo handling operations, the hazardous area on open deck may extend up to 10 m from a gas or vapour outlet in the cargo containment or handling systems.

Any enclosed or semi-enclosed spaces (not containing a source of hazard) which have direct openings, including those for ventilating systmes, which are within 10 m measured horizontally of these gas or vapour outlets, also areas on open deck which are located within **7.1**(g) and **7.1**(h) require special consideration (*see* **7.4.8**).

7.3 Enclosed Spaces Located within Hazardous Areas on Open Deck

Enclosed spaces which do not contain a source of hazard and which have openings into a hazardous area on an open weather deck shall not be considered hazardous provided all of the following conditions are met:

a) Access is by means of an air-lock;

b) The air-lock space is maintained at an overpressure relative to the external hazardous area and that the space under consideration is maintained at an overpressure relative to the air-lock space;

c) The relative overpressure between the space under consideration and air-lock space or the air flows to the space under consideration and the air-lock space are continuously monitored and so arranged that in the event of a ventilation failure an audible and visual alarm is given and the electrical supply to all equipment not of a certified safe-type is necessarily disconnected, after a reasonable time delay, if necessary. Equipment, the shut-down of which could introduce a greater hazard, shall not be disconnected;

d) Any electrical equipment required to operate when the ventilation has failed is of a certified safe-type;

e) Means are provided to ensure that electrical equipment other than of the certified safe-type may not be energized until the atmosphere within the space is made safe, for example, by air renewal of at least 10 times the capacity of the space; and

f) Audible and visual alarms are provided on each side of the air-lock which shall operate if both doors are simultaneously opened.

NOTES

1 An air-lock shall only be permitted between a hazardous area on open deck and a non-hazardous area shall be provided with two gas-tight steel doors, and the doors shall be self-closing and without holding back arrangements.

2 Both the air-lock space and the space under consideration shall be mechanically ventilated from a normally safe area.

3 The ventilation systems shall comply with **3.2**, Note 2 with the exception that all motors for driving fans shall be located outside the system ducting.

7.4 Electrical Equipment in Hazardous Areas

Electrical equipment and wiring shall not be installed in any of the defined hazardous areas unless essential for operational purposes when the installation of equipment and wiring complying with **7.4.1** to **7.4.9** may be considered.

7.4.1 *Cargo Containment Systems and Cargo Piping*

7.4.1.1 Category '*ia*' intrinsically safe apparatus and associated wiring.

7.4.1.2 Submerged cargo pump motors and their supply cables; special consideration shall be given to the type of cable and its installation.

Arrangements shall be made to automatically shut-down motors in the event of low liquid level. This may be achieved by sensing low pump discharged pressure, low motor current or low liquid level. The shut down shall be alarmed at the cargo control station. Arrangement shall also be provided to isolate motors and supply cables from their electrical supplies during gas-freeing operations.

7.4.2 Hold spaces where cargo is carried in a cargo containment system requiring a secondary barrier.

7.4.2.1 Category '*ia*' intrinsically safe apparatus and associated wiring.

7.4.2.2 Supply cables for submerged cargo pumps.

7.4.3 Hold spaces where cargo is carried in a cargo containment system not requiring a secondary barrier.

Spaces separated from the hold spaces described in **7.1** (b) by a single gas-tight steel boundary.

7.4.3.1 *Intrinsically safe apparatus and circuits*

7.4.3.2 Hull fittings containing transducers for electrical depth sounding or log devices or containing the terminals or shell plating penetrations for anodes or electrodes of an impressed current cathodic protection system for underwater protection, provided that such fittings are of a gas-tight construction or are housed within a gas-tight enclosure and are not located adjacent to the gas-tight boundary referred to in 7.1(d).

NOTE — Corrosion-resistant pipes giving adequate protection or cables associated with the above shall be used in compartments which might be filled with sea water, for example, permanent ballast tanks.

7.4.3.3 Certified safe-type luminaires of the pressurized or flameproof type arranged on at least two independent final subcircuits, all switches are protective devices shall interrupt all poles or phases and shall be located in a non-hazardous area. The luminaires, switches and protective devices shall be suitably labelled for identification purposes.

7.4.3.4 *Through-runs of cables*

Expansion bends shall not be fitted in the spaces referred to in this clause.

7.4.3.5 Certified safe-type motors of the pressurized or flame-proof type for the operation of valves for cargo and ballast systems provided that such motors are confined to those spaces described in 7.1(d).

7.4.3.6 *General alarm audible indicator*

Flameproof indicators may exceptionally be allowed.

NOTE — The above-mentioned lighting arrangements, through-runs of cables and the alarm shall not be permitted in compartments as described in 7.1(d) which are liable to be flooded for protection against 'cold spot' fractures.

7.4.4 *Cargo pump-rooms and cargo compressor rooms*

7.4.4.1 Category '*ia*' (or '*ib*') intrinsically safe apparatus and circuits.

7.4.4.2 Certified safe-type luminaires of the pressurized or flameproof type arrangement on at least two independent final sub-circuits. All switches and protective devices shall interrupt all poles or phases and shall be located in non-hazardous area. The luminaires switches and protective devices shall be suitably labelled for identification purposes.

7.4.4.3 Certified safe-type motors for cargo pumps and cargo compressors and their associated auxiliary pumps under the conditions detailed in 7.4. The associated starting and protective devices shall be installed in non-hazardous areas; any junction or branch connection boxes associate with the supply of these motors shall not be fitted in the pump-room or compressor room.

7.4.4.4 *General alarm audible indicator*

Flameproof indicators may exceptionally be allowed.

7.4.5 Areas on open deck, or semi-enclosed spaces on open deck, within 3 m of any cargo tank oulet, gas or vapour outlet, cargo pipe flange, cargo valve, or entrances and ventilation openings to cargo pump-rooms or cargo compressor rooms.

Areas within 2.4 m of the outer surface of a cargo containment system where such a surface is exposed to the weather.

Areas on open deck over all the cargo area and 3 m forward and aft of the cargo area on open deck up to a height of 2.4 m above the weather deck.

Enclosed or semi-enclosed spaces adjacent to cargo pump-rooms and cargo compressor rooms unless separated by a gas-tight deck or bulkhead and suitably mechanically ventilated.

7.4.5.1 Certified safe-type equipment as under **3.3** corresponding to the operating conditions (particularly for open deck), such as:

a) intrinsically safe apparatus;

b) luminaires;

c) branch connection boxes; and

d) motors for the ventilation of hazardous areas or for cargo located in the areas described in 7.1(f).

NOTE — The use of certified safe-type socket-outlets may be taken into consideration for supplying portable cargo pumps which are used in exceptional circumstances. In such cases, special additional precautions shall be taken such as link connections, or key interlocked change-over switches, to disconnect and earth the cables to the socket-outlets when they are not in use, also a plot indicator showing when these cables are energized. Such socket-outlets shall be supplied through an isolating transformer separating the circuit from the main supply.

7.4.6 Enclosed or semi-enclosed spaces in which pipes containing cargo products are located (*see* Note 4 to 7.1). compartments for cargo hoses.

7.4.6.1 *Intrinsically safe apparatus*

7.4.6.2 Certified safe-type luminaires of the pressurized or flameproof type arranged on at least two independent final subcircuits. All switches and protective devices shall interrupt all poles or phases and shall be located in a non-hazardous area. The luminaires, switches and protective devices shall be suitably labelled for identification purposes.

7.4.6.3 *Through-runs of cables*

Expansion bends shall not be located in these areas.

7.4.7 *Enclosed or Semi-Enclosed Spaces (Not Containing a Source of Hazard) Having an Opening into any Hazardous Area*

The electrical installation shall comply with the requirements for the space or area into which the opening leads; for exception, *see* 7. Suitability for use on open deck may require consideration in the case of a semi-enclosed space.

7.4.8 Enclosed and semi-enclosed spaces (not containing a source of hazard) which have direct openings, including those for ventilation systems, which are located more than 3 m from a gas or vapour outlet of the cargo containment or cargo handling systems and which are within 10 m measured horizontally of these outlets.

Areas on open deck more than 3 m from a gas or vapour outlet of the cargo containment or cargo handling systems and within 10 m of these outlets and which are outside the hazardous areas defined in **7.1**(g) and **7.1**(h).

7.4.8.1 Equipment of a type which ensures the absence of sparks and arcs and of 'hot spots' during its normal operation (*see* Note 1 below and *also* **3.4**) or is of a certified safe-type.

7.4.9 *All Areas on Open Deck*

Transmitting aerials, also rigging, for example, stays, provided that consideration is given to their sitting in relation to the location of gas vapour outlets.

NOTES

1 In instances where the use of equipment of the type which ensures the absence of sparks and arcs and of 'hot spots' during its normal operation is permitted within the hazardous areas defined in **7.2**, no part of such equipment shall have an operating temperature exceeding the ignition temperature of the cargo or cargoes to be carried. Furthermore, such equipment shall be approved by the recognised authority.

2 During cargo handling and gas-freeing operations gases or vapours may be present on open deck outside the areas mentioned above. Due to such possible extensions of the hazardous areas exposed equipment located on deck and on superstructures which could be in use during such opeations, for example, luminaires, winches, bridge wind apparatus, etc, shall have enclosures of degree of protection of, at least IP 56 or shall be totally encapsulated or be of the type which ensures the absence of sparks or areas and of 'hot spots' during its normal operation or have type of protection 'n' or of a certified safe-type.

3 The requirements of **7.4** do not preclude the use of winding temperature monitoring sensors in flameproof, pressurized or increased safety-type protected motors. Associated cabling should be installed in accordance with the appropriate section of **7.4**.

4 For instance where an electrically linked ship/shore emergency shut–down system is required during the transfer of a liquefied gas cargo such systems shall preferably be in accordance with the 'Recommendations and Guidelines for Linked Ship/Shore Emergency Shut-down of Liquefied Gas Cargo Transfer' issued by The Society of International Gas Tanker and Terminal Operations.

7.5 Cargo Pump Room or Cargo Compressor Room Arrangements

a) Electric motors for driving the cargo pumps or cargo compressors and their associated auxiliary pumps shall be separated from these aspaces by a gas-tight bulkhead or deck. Flexible couplings or other means of maintaining alignment shall be fitted in the shaft between the pumps or compressors and the motors and, in addition, suitable stuffing boxes shall be fitted where shafts pass through gas-tight bulkheads or decks.

b) If the motors considered in (a) above are installed in a compartment located in a hazardous area but having no direct openings into such an area and in which the ventilation ensures a permanent overpressure, the use of certified safe-type electric motors is not mandatory and the corresponding switchgear may possibly be located in this compartment provided the following conditions are met;

   i) The access to the compartment and ventilation arrangements are in accordance with 7;

   ii) The air inlets are located as remotely as possible from the hazardous areas defined in 7; and

   iii) Safe operational procedures are specified, for example, safety measures concerning the operation of the equipment, air renewal at least ten times the capacity of the compartment before total loss of overpressure.

NOTE — Where the stopping of motor driven equipment due to loss of overpressure can hazard the vessel, for example, shutting down of compressors associated with the boil-off gas–fuel burning system, certified safe-type motors shall be used and the corresponding switchgear shall be located in a non-hazardous area.

c) When operational or structual requirements are such as to make it impossible to comply with the method described in (a) above, motors of the undermentioned certified safe-types may be installed in cargo pump-rooms or cargo compressor rooms, provided they are used in conditions indicated in **7.4.4**:

i) pressurized (by means of air, inert gas or water); and

ii) increased safety with flameproof enclosure.

8 PARTICULAR CONDITIONS APPLYING TO 'TYPE D' TANKERS

NOTE — The hazardous cargoes relevant to this clause together with related data and special requirements, where applicable, are given in Annex C to this standard.

8.1 Flammable Chemical Products

The following types of products are considered, none of which present particular risks due to chemical reaction;

a) Chemicals which possess flammable characteristics similar to those of oil products and having a flash-point (closed cup test) exceeding 60°C; and

b) Chemicals which possess flammable characteristics similar to those of oil products and having a flash-point (closed cup test) not exceeding 60°C,

The hazardous areas applicable to ships intended to carry any one or more of these two types of cargo are given in **8.2** and **8.3** respectively.

Electrical equipment and wiring shall not be installed in any of the defined hazardous areas unless essential for operational purposes when the installation of equipment and wiring in compliance with **8.2** and **8.3** may be considered.

Electrical equipment and wiring permitted in other specific areas or preferred for particular applications as detailed in **8.2**.

8.2 For Chemical Cargoes Having a Flash-point (Closed Cup Test) Exceeding 60°C

8.2.1 *Unheated Cargoes and Cargoes Heated to Temperatures Less Than 15 K Below Their Flash-point*

Hazardous areas:

Cargo tanks and cargo piping only.

Electrical equipment permitted in the hazardous areas:

- Intrinsically safe apparatus and associated wiring; and
- Submerged cargo pump motors and their supply cables arranged as defined in **7.4.1.2**

Electrical equipment permitted in cargo pump-rooms:

- Equipment which ensure the absence of sparks or arcs and of 'hot spots' during its normal operation or of a certified safe type (*see* **5.3** Note 1, *also* **3.4**); and
- Through-runs of cables.

Electrical equipment without explosion risk protection but suitable for the intended location, for example, on open deck may be used elsewhere. It is, however, preferred that the intrinsically safe systems and circuits are used for measurement, monitoring, control and communication purposes which relate to the management and handling of the cargo.

8.2.2 *Cargo Heated to within 15 K of Their Flash Point*

Hazardous areas:

- Cargo tanks and cargo piping;
- Within 3 m of openings to a tank containing a heated cargo;
- Cargo pump-rooms and within 3 m of entrances or ventilation openings of cargo pump-rooms; and
- Enclosed and semi-enclosed spaces (not containing a source of hazard) and having openings within 3 m of openings to a tank containing a heated cargo or of entrances and ventilation opening or cargo pump-rooms.

Electrical equipment permitted in the hazardous areas:

- In cargo tanks and cargo piping;
- Category '*ia*' intrinsically safe apparatus and associated wiring;
- submerged cargo pump and their supply cables arranged as defined in **7.4.1.2**;
- Within 3 m of openings to a tank containing a heated cargo;
- Cargo pump-rooms and within 3 m of entrances or ventilation openings of cargo pump-rooms:

Enclosed and semi-enclosed spaces (not containing a source of hazard) having opening within 3 m of opening within 3 m of a tank containing a heated cargo or of entrances or ventilation openings of cargo pump-rooms;

i) Intrinsically safe apparatus;

ii) Certified safe-type equipment as mentioned under **3.3**; and

iii) Through runs of cables.

Electrical equipment without explosion risk protection but suitable for its intended location, for example on open deck, may be used elsewhere. It is, however, preferred, monitoring, control and communication purposes which relate to the management and handling of the cargo.

8.2.3 Cargo Heated Above Their Flash-Points

The requirements of **8.3** shall be applied excepting for the exemptions permitted for the bituminous and asphalt products referred to in **6.3**.

8.3 Cargoes having a Flash-Point (Closed Cup Test) Not Excceding 60°C

a) Hazardous areas; as defined in **5.1** together with the following additional areas:

- Void spaces adjacent to, above or below integral cargo tanks;
- Hold spaces containing independing cargo tanks;
- Pump-rooms, other than those for cargo handling, located in the cargo area;
- Enclosed and semi-enclosed spaces in which pipes containing cargo products are located;

b) Electrical equipment permitted in the hazardous areas; as defined in **5.3** together with the following additional equipment and requirements thereto:

i) In void spaces adjacent to or below integral cargo tanks:

— Devices as defined and arranged in **5.3.2**; and

— Through-runs of cables installed in heavy gauge steel pipes with gas-tight joints. Expansion bends shall not be located in these spaces.

ii) In hold spaces containing independent cargo tanks:

- Devices as defined and arranged in **5.3.2**;
- Certified safe-type luminaires as defined and arranged in **5.3.3.2**; and
- Through-round of cable.

iii) In pump-rooms, other than those for cargo handling, located in the cargo areas;

- Category '*ia*' or '*ib*' intrinsically safe apparatus circuits;
- Certified safe-type luminaires as defined and arranged in **5.3.3.2**; and
- *General alarm audible indicator* — Flameproof indicators may exceptionally be allowed.

iv) In void spaces above integral cargo tanks:

- Intrinsically safe apparatus and circuits;
- Through-runs of cables installed in heavy gauge steel pipes with gas-tight joints. Expansion bends shall not be located in these spaces; and

v) Enclosed and semi-enclosed spaces in which pipes containing cargo products are located;

- Intrinsically safe apparatus;
- Certified safe-type luminaires are defined and arranged in **5.3.3.2**; and
- Through-runs of cables.

Where cargo pumps and any associated auxiliary pumps are intended to be electrically driven the arrangement of the motors and pumps, also the ventilation of the relevant spaces, shall be in accordance with **5.4**.

9 PARTICULAR CONDITIONS APPLICABLE TO TANKERS INTENDED FOR THE CARRIAGE OF CERTAIN PRODUCTS

NOTE — Refer also to Annex C to this standard.

9.1 Highly Flammable Cargoes

9.1.1 For cargoes which have a very low flash point, high vapour pressure, a wide flammability range coupled with a very low lower explosive limits or a very low ignition temperature, the additional requirements detailed in **9.1.2** and **9.1.3** shall be applied.

9.1.2 The distances which determines the extent of the hazardous areas defined for the Types A, C and D tankers shall be increased from 3 m (or 2.4 m) to 4.5 m.

9.1.3 In the case of Type D tankers as covered by **8.3**, the hazardous areas shall also include those defined in **8.2** due account being taken of the increased distances referred to in **9.1.2**.

9.1.3.1 The electrical equipment permitted in these areas shall comply with **5.3.9**.

9.2 Chemically Unstable or Reactive Cargoes

9.2.1 For cargoes which, due to their chemical instability or to chemical reaction, may generate gases or vapour, the electrical installation shall be in accordance with **8.1**, the appropriate clause being determined by the characteristics of the intended cargoes and any generated gases and vapour and the rate(s) of generation thereof.

9.3 Cargoes Detrimental to Electrical Equipment

9.3.1 Where the cargo gases or vapours are liable to damage the materials used in the construction of electrical apparatus, careful consideration shall be given to the characteristics of the materials selected for conductors, insulation, metal parts etc. As far as is practicable, components of copper, aluminium, insulation, etc, shall be encapsulated to prevent contact with gases or vapours.

9.3.1.1 Attention is drawn to the possibility of gases and vapours being transferred from one point to another through cables or cable-ducting unless appropriate precautions are taken, for example, adequate and sealing.

9.3.2 Where components of an electrical or electronic system are liable to be in direct contact with a product, for example, for level measurement of alarm purposes, etc. it shall be ensured that the materials of such components are suitable or appropriate steps are taken to protect such components.

ANNEX A

(*Clause* 2.1)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
5572 (Part 1) : 1994	Classification of hazardous areas (Other than mines) for electrical installation : Part 1 Areas having flammable gases and vapours (*first revision*)
6381 : 1972	Specification for construction and testing of electrical apparatus with type of protection '*e*'
10242 (Part 2/Sec 1) : 1982	Specification for electrical installations in ships : Part 2 System design, Section 1 General
10242 (Part 3/Sec 12) : 1986	Specification for electrical installations in ships : Part 3 Equipment, Section 12 Choice and installation of cables for low voltage systems
10242 (Part 4) : 1992	Specification for electrical installations in ships : Part 4 Installation and test of completed installation

ANNEX B

(*Clause* 3.3)

CONDITIONS FOR CERTIFIED SAFE-TYPE EQUIPMENT

B-1 SCOPE

The following requirements are applicable to the certified safe-type equipment for use in tankers, as given in **3.3** of this standard, in addition to relevant Indian Standard Specification on Electrical apparatus for explosive atmospheres.

B-2 FLAMEPROOF PROTECTION

B-2.1 General

B-2.1.1 Materials constituting structural gaps upon which the safety characteristics of the enclosures are based shall be of corrosion-resistant nature for the envisaged use and suitably protected against the effect of moisture and entry of water, where necessary.

B-2.1.2 Aluminium alloys for flameproof enclosures shall not include more than 6 percent magnesium.

B-2.1.3 Equipment is to be constructed and marked for use in an ambient temperature of 50°C.

B-2.1.4 Preference shall be given to design which require unit or component replacement rather than repair to avoid loss of flameproof characteristics due to poor maintenance. Additionally, the manufacturer shall indicate the nature and frequency of the maintenance required while in service and the precuations to be taken to ensure that the safety characteristics are retained.

B-2.2 Particulars

B-2.2.1 *Luminaires*

B-2.2.1.1 The maximum power of the lamp which may be palced in the luminaire without jeopardizing the safety characteristics of the fitting shall be clearly indicated on the nameplate.

B-2.2.1.2 The temperature rise of the terminals during operation at the power referred to above shall be clearly indicated by the manufacturer to allow appropriate selection of the connecting cables.

B-2.2.1.3 Suitable mechanical protection shall be provided for the cover glasses where such protection is considered necessary.

B-2.2.1.4 Luminaires of the 'through-bulkhead' type shall not impair the integrity of the bulkhead into which they are fitted.

B-2.2.2 *Branch Connection Boxes*

B-2.2.2.1 Steps shall be taken to prevent the accumulation of moisture (including condensation effects) within the enclosure, where this is not feasible, components within the enclosure shall be of the increased-safety type ('*e*' type). Consideration shall be given treating the components, when secured, with suitable water repellant compound.

B-2.2.3 *Motors*

B-2.2.3.1 Where a degree of protection of enclosure of IP 56 is required, all joints shall be protected against the effects of moisture and entry of water. In addition, suitable glands shall be provided for rotating shafts, such glands being external to the flameproof gland.

B-2.2.3.2 Where fans are outside the flameproof enclosure, their materials, together with those of their protective enclosures, shall be such that no dangerous sparking may arise in case of relative displacement; due consideration shall be given to antistatic properties of any synthetic materials used in the construction of such fans.

B-2.2.3.3 Suitable arrangements shall be provided to enable any accumulated moisture to be removed from the enclosure; such arrangements shall not impair the flameproof characteristics of the enclosure even when the drain is in the open position.

B-3 INCREASED SAFETY PROTECTION ('e' TYPE)

B-3.1 General

B-3.1.1 The characteristics of the increased safety feature shall be at least equal to those applicable for the mining industry, unless hereafter specified.

B-3.1.2 All the components upon which the safety characteristics of the apparatus are based shall be of a corrosion-resistant nature.

B-3.1.3 Equipment shall be constructed and marked for use in an ambient temperature of 50°C.

B-3.1.4 Air clearance and creepage distances shall not be less than those stated by IS 6381 : 1972.

B-3.2 *Branch Connnection Boxes*

B-3.2.1 Insulating parts shall be selected in accordance with the temperature class of the cables to be connected.

B-3.2.2 Consideration shall be given to treating the components within the enclosures, when secured, with a suitable water repellent compound.

B-3.3 *Motors*

B-3.3.1 Motors having a synchronous speed in excess of 1 800 rev/min shall not be used.

B-3.3.2 To minimize accumulation of moisture within the enclosure, suitable internal heating shall be provided (preferably by low-voltage supply injection to the stator windings) for the periods when the motor is not in use. Interlocking shall be either provided or included to ensure that the heating circuits are disconnected prior to starting the motor. Heating arrangements and the temperature levels obtained thereby shall not be harmful to the windings.

B-3.3.3 The insulation covering of stator conductor shall be made of at least three layers, one of which shall be glass-braid. Alternatively, for small machine, plain double-enamelled wires may be used provided all the windings are encapsulated.

Limiting temperatures, as well as ratings, shall be based on an ambient temperature of 50°C.

B-3.3.4 Temperature detectors shall be fitted in windings to ensure that limits of temperature are not exceeded; in addition, a combined single characteristic shall be fitted in the starter.

The motor and its starter shall undergo combined tests.

B-3.3.5 Cylindrical-type roller bearings shall not be used.

B-4 INTRINSIC SAFETY PROTECTION

B-4.1 General

B-4.1.1 *Wiring*

See **4.3** of this standard.

B-4.1.2 In order to maintain the intrinsically safe characteristics of system, such systems shall generally include only the equipment in hazardous areas and any additions which are essential for the operation of the system.

B-5 PRESSURIZED PROTECTION

B-5.1 General

B-5.1.1 To ensure an uncontaminated air supply when air is used as the pressurizing medium, air inlets to the system shall be located in a non-hazardous areas and as far as practicable from any hazardous area.

B-5.1.2 Whenever air or inert gas is used as a pressurizing medium, suitable interlocks shall be provided to ensure a displacement of air within the apparatus of at least ten times the free volume of its enclosure and that the required pressure is obtained before it may be energized. Protection of the enclosed electrical equipment from external effects shall not be dependent upon the pressurizing arrangements.

B-5.1.3 Whenever the medium is air, inert gas or water, then in general, the loss of pressure within the enclosure shall automatically disconnect the apparatus; however, if this would increase the hazard to the vessel, in a particular application it may be permitted for loss of pressure to operate an alarm device only.

ANNEX C

(*Clause* 9)

QUALIFICATION OF LIQUID PRODUCTS WITH REGARD TO HAZARDS TO OR FROM ELECTRICAL INSTALLATIONS

C-1 The products below have been considered in relation to the following categories which are appropriate when indicated by '×' in the table below.

a) Risks similar to those given or liquid or liquefied cargoes on board oil tankers or gas carriers of Types A, B, or C;

b) Higher risks;

c) Risks resulting from the possibility of flammable gas or vapour production (mainly hydrogen) due to chemical reaction; and

d) Risks due to corrosion of standard elelctro-technical materials (aluminium, copper, rubber or rubberlike compound, etc.

NOTES

1 Attention is drawn to the fact that the indicated classification concerns only risks in connection with the electrical installation. conerning electrotechnical materials have not been taken into consideration.

2 Products other than those included in this list shall be given special consideration.

Product	*Category*			
	1	2	3	4
Acetaldehyde		×		
Acetic acid	×			
Acetic anhydride	×			
Acetone	×			
Acrolein	×			
Acrylonitrile	×			×
Allyl chloride	×			
Ammonia	×			×
Amyl acetate p.	×			
Amyl acetate sec.	×			
Amyl alcohol p.	×			
Amyl alcohol sec.	×			
Amyl alcohol ter	×			
Benzene	×			
Benzyl alcohol	×			
Butyl acetate p.	×			
Butyl acetate sec.	×			
Butyl alcohol p.	×			
Butyl alcohol sec.	×			
Butyl alcohol ter.	×			
Butyraldehyde	×			
Carbon disulphide		×		
Carbon tetrachloride				×
'Carbowzx' methoxy-polyethylene glycol 350 and 550	×			
Chlorobenzene	×			
Chlorosulphonic acid		×		
Crotonaldehyde	×			
Cumene	×			
Cyclohexane	×			

Product	*Category*			
	1	2	3	4
Cyclohexanol	×			
Decyl alcohol	×			
Diamine ethyl	×			×
Dicloropropene	×			
Diethylene glycol	×			
Diethylene glycol monoethyl ether 'Carbitol'	×			
Dipentene	×			
Dipropylene glycol	×			
Ethyl acetate	×			
Ethyl acrylate	×			
Ethyl alcohol	×			
Ethyl chloride		×		
Ethyl ether		×		
Ethylene glycol	×			
Ethylene glycol monethyl ether ('Cello Solve')				
Ethylene glycol monethylene ether acetate ('cellosolve' acetate)	×			
Ethylene imine		×		
Ethyl methyl ketone	×			
Furfural	×			
Furfuryl alcohol	×			
Formaldehyde (aqueous solution)	×			
Glycerol	×			
Heptane	×			
Heptyl alcohol (1-Heptanol)	×			
Hexane	×			
Hexyl alcohol (1-Hexanol)	×			
Hexylene glycol	×			
Hydrochloric acid			×	
Hydrofluoric acid			×	
Isoamyl acetate	×			
Isoamyl alcohol p.	×			
Isoamyl alcohol sec.	×			
Isobutyl acetate	×			
Isobutyl alcohol	×			
Isobutyl aldehyde	×			
Isobutyl methyl ketone	×			
Isooctane	×			
Isopropyl acetate	×			
Isopropyl alcohol	×			
Methyl acrylate	×			
Methoxynolamine				×
Morpholine	×			×
Nonyl alcohol (di-isobutyl carbinol)	×			
Octane	×			
Octene	×			
Octy alcohol (2-ethylexyl alcohol)	×			
Perchlorethylene	×			
Phenol			×	
Phosphoric acid		×		

Product	*Category*			
	1	2	3	4
Potassium (aqueous solution)				×
Propionaldehyde	×			
Propyl acetate	×			
Propyl alcohol	×			
Propylene dichloride	×			×
Propylene glycol	×			
Propylene oxide		×		×
Soda (aqueous solution)				×
Styrene (monomer)	×			×
Sulphuric acid			×	
Tetrapropylene	×			
Trichloroethane alpha	×			
Trichloroethane beta	×			
Triethylene glycol	×			
Toluene	×			
Turpentine	×			
Vinyl acetate	×			
Xylene	×			

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BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 323 01 31, 323 94 02, 323 33 75

Telegrams: Manaksanstha
(Common to all offices)

Regional Offices:	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	323 76 17 323 38 41
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